

# TYPES SN5440, SN54H40, SN54LS40, SN54S40, SN7440, SN74H40, SN74LS40, SN74S40 DUAL 4-INPUT POSITIVE-NAND BUFFERS

REVISED APRIL 1985

- Package Options Include Both Plastic and Ceramic Chip Carriers in Addition to Plastic and Ceramic DIPs
- Dependable Texas Instruments Quality and Reliability

## description

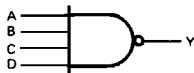
These devices contain two independent 4-input NAND buffer gates.

The SN5440, SN54H40, SN54LS40, and SN54S40 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7440, SN74H40, SN74LS40, and SN74S40 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

FUNCTION TABLE (each gate)

INPUTS				OUTPUT
A	B	C	D	Y
H	H	H	H	L
L	X	X	X	H
X	L	X	X	H
X	X	L	X	H
X	X	X	L	H

## logic diagram (each gate)

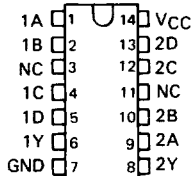


## positive logic

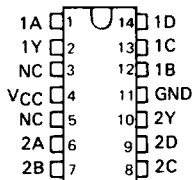
$$Y = \overline{A \cdot B \cdot C \cdot D} \text{ or } Y = \overline{A} + \overline{B} + \overline{C} + \overline{D}$$

SN5440, SN54H40 ... J PACKAGE  
SN54LS40, SN54S40 ... J OR W PACKAGE  
SN7440, SN74H40 ... J OR N PACKAGE  
SN74LS40, SN74S40 ... D, J OR N PACKAGE

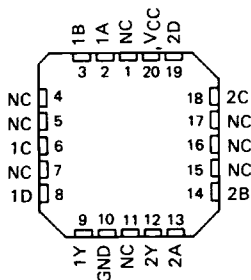
(TOP VIEW)



SN5440, SN54H40 ... W PACKAGE  
(TOP VIEW)



SN54LS40, SN54S40 ... FK PACKAGE  
SN74LS40, SN74S40 ... FN PACKAGE  
(TOP VIEW)



NC - No internal connection

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## PRODUCTION DATA

This document contains information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

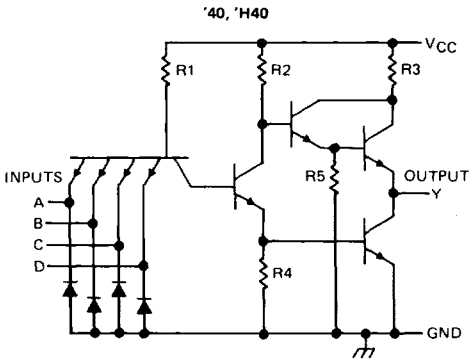
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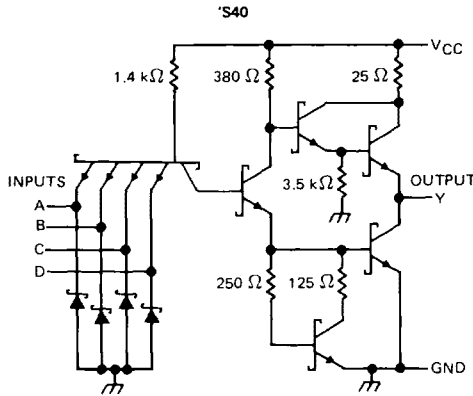
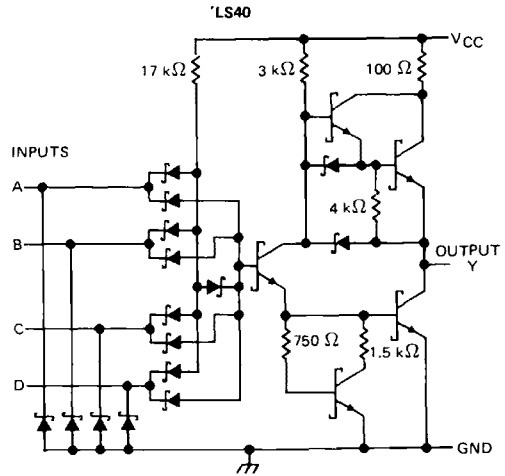
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# TYPES SN5440, SN54H40, SN54LS40, SN54S40, SN7440, SN74H40, SN74LS40, SN74S40 DUAL 4-INPUT POSITIVE-NAND BUFFERS

schematics (each gate)



CIRCUIT	R1	R2	R3	R4	R5
'40	4 k $\Omega$	600 $\Omega$	100 $\Omega$	400 $\Omega$	4 k $\Omega$
'H40	1.4 k $\Omega$	390 $\Omega$	45 $\Omega$	250 $\Omega$	2 k $\Omega$



Resistor values shown are nominal.

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absolute maximum ratings over operating free-air temperature (unless otherwise noted)

Supply voltage, $V_{CC}$ (see Note 1)	7 V
Input voltage: '40, 'H40, 'S40	5.5 V
'LS40	7 V
Operating free-air temperature: SN54'	-55°C to 125°C
SN74'	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

# TYPES SN5440, SN7440

## DUAL 4-INPUT POSITIVE-NAND BUFFERS

### recommended operating conditions

	SN5440			SN7440			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub> Supply voltage	4.5	5	5.5	4.75	5	5.25	V
V <sub>IH</sub> High-level input voltage	2			2			V
V <sub>IL</sub> Low-level input voltage			0.8			0.8	V
I <sub>OH</sub> High-level output current			-1.2			-1.2	mA
I <sub>OL</sub> Low-level output current			48			48	mA
T <sub>A</sub> Operating free-air temperature	-55		125	0		70	°C

### electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS †	SN5440			SN7440			UNIT
		MIN	TYP ‡	MAX	MIN	TYP ‡	MAX	
V <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = -12 mA			-1.5			-1.5	V
V <sub>OH</sub>	V <sub>CC</sub> = MIN, V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = -1.2 mA	2.4	3.3		2.4	3.3		V
V <sub>OL</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 48 mA		0.2	0.4		0.2	0.4	V
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V			1			1	mA
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.4 V			40			40	µA
I <sub>IL</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V			-1.6			-1.6	mA
I <sub>OS</sub> §	V <sub>CC</sub> = MAX	-20		-70	-18		-70	mA
I <sub>CCH</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0 V		4	8		4	8	mA
I <sub>CCL</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 4.5 V		17	27		17	27	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

§ Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed 100 milliseconds.

### switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see note 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS		MIN	TYP	MAX	UNIT
t <sub>PLH</sub>	Any	Y	R <sub>L</sub> = 133 Ω,	C <sub>L</sub> = 15 pF		13	22	ns
t <sub>PHL</sub>						8	15	ns

NOTE 2: See General Information Section for load circuits and voltage waveforms.

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# TYPES SN54H40, SN74H40

## DUAL 4-INPUT POSITIVE-NAND BUFFERS

### recommended operating conditions

	SN54H40			SN74H40			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$ Supply voltage	4.5	5	5.5	4.75	5	5.25	V
$V_{IH}$ High-level input voltage	2			2			V
$V_{IL}$ Low-level input voltage	0.8			0.8			V
$I_{OH}$ High-level output current	-1.5			-1.5			mA
$I_{OL}$ Low-level output current	60			60			mA
$T_A$ Operating free-air temperature	-55			0			$^{\circ}$ C

### electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS †	SN54H40			SN74H40			UNIT	
		MIN	TYP ‡	MAX	MIN	TYP ‡	MAX		
$V_{IK}$	$V_{CC} = \text{MIN.}$ , $I_I = -8 \text{ mA}$	-1.5			-1.5			V	
$V_{OH}$	$V_{CC} = \text{MIN.}$ , $V_{IL} = 0.8 \text{ V}$ , $I_{OH} = -1.5 \text{ mA}$	2.4	3.4		2.4	3.4		V	
$V_{OL}$	$V_{CC} = \text{MIN.}$ , $V_{IH} = 2 \text{ V}$ , $I_{OL} = 60 \text{ mA}$	0.2	0.4		0.2	0.4		V	
$I_I$	$V_{CC} = \text{MAX.}$ , $V_I = 5.5 \text{ V}$	0.1			0.1			mA	
$I_{IH}$	$V_{CC} = \text{MAX.}$ , $V_I = 2.4 \text{ V}$	0.1			0.1			mA	
$I_{IL}$	$V_{CC} = \text{MAX.}$ , $V_I = 0.4 \text{ V}$	-4			-4			mA	
$I_{OS} §$	$V_{CC} = \text{MAX.}$	-40	-125		-40	-125		mA	
$I_{CCH}$	$V_{CC} = \text{MAX.}$ , $V_I = 0 \text{ V}$	10.4			10.4			16	mA
$I_{CCL}$	$V_{CC} = \text{MAX.}$ , $V_I = 4.5 \text{ V}$	25			25			40	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^{\circ}\text{C}$ .

§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second.

### switching characteristics, $V_{CC} = 5 \text{ V}$ , $T_A = 25^{\circ}\text{C}$ (see note 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS		MIN	TYP	MAX	UNIT	
$t_{PLH}$	Any	Y	$R_L = 93 \Omega$ ,	$C_L = 25 \text{ pF}$			8.5	12	ns
$t_{PHL}$					6.5	12	ns		

NOTE 2: See General Information Section for load circuits and voltage waveforms

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# TYPES SN54LS40, SN74LS40 DUAL 4-INPUT POSITIVE-NAND BUFFERS

## recommended operating conditions

	SN54LS40			SN74LS40			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub> Supply voltage	4.5	5	5.5	4.75	5	5.25	V
V <sub>IH</sub> High-level input voltage	2			2			V
V <sub>IL</sub> Low-level input voltage				0.7			V
I <sub>OH</sub> High-level output current				- 1.2			mA
I <sub>OL</sub> Low-level output current				12			24
T <sub>A</sub> Operating free-air temperature	- 55			125			0
				70			°C

## electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS †	SN54LS40			SN74LS40			UNIT
		MIN	TYP ‡	MAX	MIN	TYP ‡	MAX	
V <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = - 18 mA	- 1.5			- 1.5			V
V <sub>OH</sub>	V <sub>CC</sub> = MIN, V <sub>IL</sub> = MAX, I <sub>OH</sub> = - 1.2 mA	2.5	3.4		2.7	3.4		V
V <sub>OL</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 12 mA	0.25			0.4			
	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 24 mA				0.35			0.5
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V				0.1			0.1
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V				20			20
I <sub>IL</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V				- 0.4			- 0.4
I <sub>OS</sub> §	V <sub>CC</sub> = MAX	- 30			- 130			- 30
I <sub>CCH</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0 V	0.45			1			0.45
I <sub>CCL</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 4.5 V	3			6			3
					6			6

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

§ Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.

## switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see note 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS		MIN	TYP	MAX	UNIT
t <sub>PLH</sub>	Any	Y	R <sub>L</sub> = 667 Ω,	C <sub>L</sub> = 45 pF			12	24
t <sub>PHL</sub>							12	24

NOTE 2: See General Information Section for load circuits and voltage waveforms

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# TYPES SN54S40, SN74S40

## DUAL 4-INPUT POSITIVE-NAND BUFFERS

### recommended operating conditions

	SN54S40			SN74S40			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$ Supply voltage	4.5	5	5.5	4.75	5	5.25	V
$V_{IH}$ High-level input voltage	2			2			V
$V_{IL}$ Low-level input voltage	0.8			0.8			V
$I_{OH}$ High-level output current	-3			-3			mA
$I_{OL}$ Low-level output current	60			60			mA
$T_A$ Operating free-air temperature	-55			125			°C

### electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS †	SN54S40		SN74S40		UNIT
		MIN	TYP ‡ MAX	MIN	TYP ‡ MAX	
$V_{IK}$	$V_{CC} = \text{MIN}$ , $I_I = -18 \text{ mA}$	-1.2		-1.2		V
$V_{OH}$	$V_{CC} = \text{MIN}$ , $V_{IL} = 0.8 \text{ V}$ , $I_{OH} = -3 \text{ mA}$	2.5	3.4	2.7	3.4	V
$V_{OL}$	$V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ , $I_{OL} = 60 \text{ mA}$	0.5		0.5		V
$I_I$	$V_{CC} = \text{MAX}$ , $V_I = 5.5 \text{ V}$	1		1		mA
$I_{IH}$	$V_{CC} = \text{MAX}$ , $V_I = 2.7 \text{ V}$	0.1		0.1		mA
$I_{IL}$	$V_{CC} = \text{MAX}$ , $V_I = 0.5 \text{ V}$	-4		-4		mA
$I_{OS} §$	$V_{CC} = \text{MAX}$	-50	-225	-50	-225	mA
$I_{CCH}$	$V_{CC} = \text{MAX}$ , $V_I = 0 \text{ V}$	10	18	10	18	mA
$I_{CCL}$	$V_{CC} = \text{MAX}$ , $V_I = 4.5 \text{ V}$	25	44	25	44	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed 100 milliseconds.

### switching characteristics, $V_{CC} = 5 \text{ V}$ , $T_A = 25^\circ\text{C}$ (see note 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{PLH}$	Any	Y	$R_L = 93 \Omega$ ,	$C_L = 50 \text{ pF}$	4	6.5	ns	
$t_{PHL}$					4	6.5	ns	
$t_{PLH}$			$R_L = 93 \Omega$ ,	$C_L = 150 \text{ pF}$	6		ns	
$t_{PHL}$					6		ns	

NOTE 2: See General Information Section for load circuits and voltage waveforms.

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